Corsepius, Uwe

Working Paper

Interest rate reform and private investment behaviour in developing countries: Evidence from Peru

Kiel Working Papers, No. 317

Provided in cooperation with:
Institut für Weltwirtschaft (IfW)

Suggested citation: Corsepius, Uwe (1988) : Interest rate reform and private investment behaviour in developing countries: Evidence from Peru, Kiel Working Papers, No. 317, http://hdl.handle.net/10419/47158

Kieler Arbeitspapiere
Kiel Working Papers

Kiel Working Paper No. 317

Interest Rate Reform and Private Investment Behaviour in Developing Countries: Evidence from Peru

by
Uwe Corsepius

Institut für Weltwirtschaft an der Universität Kiel
The Kiel Institute of World Economics

ISSN 0342-0787

Kiel Institute of World Economics
Department IV
Düsternbrooker Weg, D-2300 Kiel
West-Germany

Kiel Working Paper No. 317

Interest Rate Reform and Private Investment Behaviour in Developing Countries: Evidence from Peru

by
Uwe Corsepius

February 1988

ISSN 0341 - 0787

Table of Contents

List of Tables

Interest Rate Reform and Private Investment Behaviour in Developing Countries: Evidence from Peru*

I. Introduction

The principle aims to be achieved by financial liberalization in financially repressed developing countries are to increase the volume of investments and to improve their allocative efficiency. The theoretical and empirical literature stresses the importance of raising real interest rates in countries with interest rate ceilings and permanently or at least temporary negative real interest rates[1]. This reform proposal is based on the expectation that higher real interest rates would induce private households to save more in the commercial banking system, thereby enabling financial institutions to expand their credit supply to private firms. Assuming that private investments were constrained by the non-availability of credit before the financial reform was implemented, those firms are supposed to increase their real capital formation[2].

The empirical evidence confirms at least for Asian developing countries that financial savings do indeed increase in response to higher real interest rates (Corsepius, Fischer, 1987a). However, some authors (Roe, 1986; Snowden, 1987) refer to the experiences with financial liberalization in Chile and Turkey and question the desirability of higher interest rates from a firm-specific perspective. According to their reasoning, higher interest rates for bank credits squeeze the profitability of private firms, thus largely offsetting the positive impact of the increased availability of bank credit.

---

* Financial support of the Fritz Thyssen Stiftung and helpful comments of B. Fischer are gratefully acknowledged.

1 For a survey of the theoretical and empirical literature, see Fischer (1982), Fry (1982) and Gupta (1984).

2 Among the problems which are excluded by this assumption are the impact of extensive regulation of commercial banks and the flow of funds between formal and informal financial markets on the volume of the loanable funds. Furthermore, other options for commercial banks, such as government or foreign securities, could be considered rather than to lend additional funds to private companies. For further theoretical considerations, see Corsepius (1986) and Galbis (1986).

In order to evaluate the validity of the above outlined criticism this article tries to shed some light on the relationship between interest rate reform and private capital formation using data from Peru. The next section discusses whether interest rates necessarily have to increase for borrowers if interest rates on deposits are raised. Assuming that interest for bank credits increase, the third section uses a theoretical model to show how total interest payments for private firms change. The first part of the fourth section deals with the question whether different means to raise real interest rates, i.e. lowering inflation or raising nominal interest rates, are symmetric in their impact on private capital formation. To capture the impact of lowering inflation on private real capital formation, in the second part of section four an investment model incorporating inflation effects is tested econometrically with Peruvian data. The final section provides some tentative policy conclusions with respect to an appropriate policy mix for financial reforms.

II. Implications of Higher Deposit Rates for Interest Rates on Bank Credit

Several arguments can be put forward why increases in deposit rates need not imply higher interest rates for bank credits. In financially repressed economies with interest rate ceilings and segmented credit markets banks are often able to expand the spread between the interest rate on deposits and for credits above the competitive equilibrium value[1]. In particular, they tend to stick to the ceilings for deposits but evade interest rate controls for loans. The effective interest rate paid by firms is increased through compensating balances or discounting of credits (Fry, 1982). Inefficient intermediation, i.e. excessive operating costs, or monopoly profits are the consequences. Thus, measures to increase competition in the banking sector may set enough resources free to finance higher interest rates on deposits.

---

[1] See, for example, the case of the banking sector in Thailand (Corsepius, Fischer, 1987b).

In order to assess the magnitude in which more efficient intermediation can finance higher deposit rates Peruvian data are employed. Intermediation costs are measured by calculating the ratio of operating costs to total assets over the period 1978-80. The data are derived from balance sheets and the consolidated income account of the commercial banking system[1]. This yields a value of 5.6% for Peru compared to 4.4% for Colombia and 2.4% for Thailand (Rocha, 1986). In addition, the ratio of profits before tax to total assets was in 1981 2.1% in Peru but only 1.3% (1980) in Colombia and 1.5% (1980) in Thailand. These figures suggest that the Peruvian banks have earned relatively high profits while being comparatively cost-intensive. To arrive at a benchmark estimate for potential efficiency gains, it is optimistically assumed that a financial reform succeeds in cutting operating costs and profits by half. In the case of the three largest private commercial banks this would have freed enough resources to increase interest rates for existing time and saving deposits on average by 7.4 percentage points during the years 1978-80 and 4.2 percentage points in 1984-85. Considering, however, that the effective ex-post real interest rate on saving accounts was on average -42.9% in the period 1978-80 and -45.0% in 1984-85, even drastic improvements in the intermediation efficiency would alone not have been sufficient to finance positive ex-post real interest rates on existing deposits.

Besides operating costs and profits, other main determinants of the spread between interest rates for deposits and credits are taxes, legal reserve requirements and obligations to lend at preferential rates to certain groups of borrowers. Abstracting from costs and profits and assuming that no interest is earned on legal reserves, the required interest rate spread increases proportionally with the reserve requirement[2]. For example, during

---

[1] The commercial banking system includes: Private and public commercial banks, regional banks, savings banks. For the data see Superintendencia de Banca y Seguros, Memoria, various issues.

[2] The loan rate required to cover the costs of all deposits equals:
(Deposit rate)/(1-Reserve Requirement).

1978-80 in Peru the weighted average interest rate paid on deposits in national currency was 11.6%, while the average basic reserve requirement was 49.1% over the same period. Thus, the average loan rate necessary to cover interest payments on deposits would have been 22.8%.

The effects of portfolio restrictions, which require banks to invest in low yielding government securities or extend credits to certain borrowers at preferential interest rates, are similar to those of reserve requirements. However, since banks earn some interest on those funds, their impact on spreads is smaller such as in those cases where some interest is paid on reserves (Hanson, 1986).

In sum, deregulation of the banking sector and efficiency gains through increased competition will provide banks with substantial resources. These can be used to finance higher deposit rates while keeping lending rates constant. However, as operating costs can only be reduced gradually over time, in the short-run some increase in credit interest rates may be inevitable. Whether higher interest rates for bank credits imply an increasing total interest burden for investment financing of private firms is analyzed in the next section.

III. Raising Interest Rates for Bank Credit and the Interest Costs for Private Firms

In developing countries with financial repression private firms borrow in the formal as well as in the informal credit market. Average interest costs for all firms are, therefore, a weighted average of interest rates in both markets. How a rise in interest rates for bank credit affects average interest costs, depends on the relationship between the informal and the formal credit market. Snowden (1987), for example, assumes implicitly that the credit markets are completely segmented. Thus, the interest rate and the credit volume in the informal financial sector are not affected by a financial reform in the formal market. Accordingly, higher interest rates for bank credits will depress corporate

profits and the ability of firms to accumulate equity through retentions. However, the plausibility of Snowden's assumption is disproved by empirical evidence from several countries (Acharya, Madhur, 1983; Wijnbergen, 1983; Corsepius, Fischer, 1987b). These studies show that higher interest rates in the banking system reduce interest rates and the credit volume in the informal financial sector. Thus, the results support a substitutionary relationship between both credit markets. Based on this evidence the following linear model is used to examine whether Snowden's criticism of financial liberalization still holds:

$$q_F^S = a + b\bar{i}_F = \bar{q} \qquad (1)$$

$$q_F^D = c + d\bar{i}_F \qquad (2)$$

$$q_I^S = r_1\, a + bi_I - \bar{q} \qquad (3)$$

$$q_I^D = r_2\, c + di_I - \bar{q} \qquad (4)$$

$$q_F^d = q_F^S \qquad (5)$$

$$q_I^D = q_I^S \qquad (6)$$

The subscripts F and I stand for the formal and informal credit market, respectively. q^D (q^S) denotes the credit demand (supply) quantity, i is the interest rate and a, b, c, d are parameters of supply and demand functions with a, b, c $>$ 0, d $<$ 0. r_1 with $0 < r_1 < 1$ is a risk parameter. Informal credit arrangements are prohibited in many developing countries. Savers will, therefore, demand a risk premium if they offer their savings in the informal financial sector. The higher the punishment the lower will be the credit supply in the informal market and r_1 approaches zero. On the contrary, if the risks in both credit markets are the same, r_1 would equal one. $r_2 > 1$ takes account of inefficient credit rationing in the formal sector. As authorities fix the interest rate in the formal financial sector ($\bar{i}_F$) below its equilibrium value, the supply is limited to $\bar{q}$ and excess demand exists. Since banks cannot raise interest rates, they maximize profits by mini-

mizing default risks. This procedure cannot assure that those with the most efficient investment projects and the highest willingness to pay are satisfied (Cho, 1986). The credit demand in the informal financial market will thus be higher for any given interest rate i_I than it would have been with efficient allocation in the formal sector. The less efficient the credit rationing mechanism the higher will r_2 be. In the absence of efficiency losses r_2 would assume a value of one. As the authorities influence r_1 and r_2 through the penalties for informal credit arrangements and the degree of regulation in financial markets, r_1 and r_2 may be thought of as indirect policy parameters of the model, while i_F being fixed by interest rate ceilings is a direct policy variable.

In this model financial liberalization will unify both credit markets resulting in a uniform credit interest rate (i*). In order to measure the effects of financial liberalization on interest costs of private firms the difference (Δi) between average interest costs per unit of credit after and before deregulation is calculated. A positive difference implies that the interest burden for private firms has increased due to financial liberalization:

$$\Delta i = i^* * \frac{q^S}{q^S} - \frac{\bar{q}_F \bar{i}_F + q_I i_I}{\bar{q}_F + q_I} \qquad (7)$$

Solving for equilibrium interest rates before and after liberalization, and substituting the results into equation 7 yields:

$$\Delta i = \frac{(r_2 c + d i_I)\ ((c+di_I) - (a+bi_I)) - (b-d)\ (\bar{i}_F - i_I) q}{(b-d)\ (r_2 c + d i_I)} \gtrless 0 \qquad (8)$$

Equation 8 shows that financial liberalization may increase or decrease the interest burden for private debtors depending on the relative size of r_1, r_2 and $\bar{i}_F$. To evaluate which policies are conducive for a cost reduction, (8) is partially differentiated with respect to its policy parameters r_1, r_2, $\bar{i}_F$:

$$\frac{\delta}{\delta r_1}(\Delta i) = \frac{q\,(r_2c + d\bar{i}_F) - (r_2c + di_I)^2}{(b-d)\,(r_2c + di_I)^2} \gtrless 0 \qquad (9)$$

$$\frac{\delta}{\delta r_2}(\Delta i) = \frac{c(q\,(r_2c + di_I + b(\bar{i}_F - i_I)) - (r_2c + di_I)^2)}{(b-d)\,(r_2c + di_I)^2} < 0 \qquad (10)$$

$$\frac{\delta}{\delta i_F}(\Delta i) = \frac{-\,(a + b\bar{i}_F)}{r_2c + di_I} < 0 \qquad (11)$$

It follows from the partial derivatives that financial liberalization tends to decrease average interest costs, if

- the difference between the interest rate ceiling and the equilibrium interest rate is high, i.e. the lower $\bar{i}_F$;
- the rationing process is rather inefficient, i.e. the higher r_2.

If the authorities fix interest rates substantially below their equilibrium values, the informal financial sector will be relatively large. Due to risk considerations and inefficient credit rationing interest rates in the informal market are higher than the uniform rate after deregulation. As the financial reform reduces interest rates for a large portion of credits, total interest costs for private firms will diminish. Furthermore, relative inefficient credit allocation in the formal financial sector raises the willingness to pay in the informal market. Therefore, the volume and interest rates increase in the informal sector. With financial liberalization the reduction in interest costs is then relatively large.

Equation 9 indicates that an interest rate reform is ambiguous in its effect on the change in interest costs with respect to r_1. A high risk associated with severe punishment of informal financial dealings increases the interest rate for informal credits. However, with given demand the size of the informal sector shrinks. A smaller volume of informal credits means less potential gains from financial liberalization, while higher interest rates for informal credits imply a reduction in total interest costs after deregulation. Which effect dominates, depends on the interest

elasticity of the demand for informal credits. With a low elasticity, i.e. small values of d, informal interest rates will rise but the credit volume remains nearly unchanged. Thus, financial liberalization will lower total interest costs if r_1 is relatively low.

The results disprove Snowden's conclusion that higher interest rates for bank credits will necessarily increase the average credit interest rate for firms. Particularly in economies, where the informal financial market is large as in Peru[1] and the formal sector's credit allocation rather inefficient, the average interest rate for all firms taken together is likely to decrease through financial liberalization.

IV. Inflation and Private Investment Behaviour

So far it has been left open how real interest rates are to be raised. Most theoretical analyses do not differentiate between increases of nominal interest rates and a reduction of the inflation rate[2]. In many financial reforms, for example in Argentina and Indonesia (Alonso, 1984; Nunnenkamp, 1986), higher real interest rates were achieved by shifting nominal rates upwards rather than lowering inflation. In a stable economic environment without distortionary taxes both measures increase real financing costs for firms and should have identical effects on private investment[3]. However, high rates of inflation are generally considered to impede private capital formation irrespective of real interest rates. Since inflation induced uncertainty is positively associated with the level of inflation, risk averse investors

---

[1] According to Susano (1983) in Peru the volume of the informal credits is three times as large as all credits extended by the formal financial sector.

[2] Some authors, however, prefer higher nominal interest rates because interest rate ceilings are easier to change than inflation rates (Moore, Chowdury, 1981).

[3] This statement does not hold in the presence of progressive taxes. The real tax burden increases in a system based on nominal values as inflation rises. Lower rates of inflation should then be relatively more favourable for private investors.

will reduce their investment spending as inflation accelerates. Empirical evidence confirming a positive relationship between the level of inflation and its volatility is provided by Logue, Willet (1976), Blejer (1979) and Fischer (1981). Although volatile inflation rates and uncertainty are not the same thing, fluctuating inflation rates may be thought of as indicating unstable macroeconomic policies and thus an uncertain economic environment.

In order to evaluate the effects of inflation induced uncertainty on investment behaviour first an aggregate investment model is formulated. In a second step the model is tested econometrically with Peruvian data.

1. The Model

Models of private investment behaviour generally being used in theoretical and empirical applications do not allow for a separate influence of inflation[1]. An exception is the work of Maloney, Prinzinger, and Ulbrich (1982) who introduced the actual rate of inflation in a modified quarterly accelerator model of investment for the United States. They found a negative and statistically significant relationship between inflation and the real change of expenditures for new plants and equipment. They attribute their results to the interaction of inflation and a progressive tax structure which reduces the profitability of funds invested in real capital formation relative to other uses such as gold or investment in housing.

However, in highly inflationary developing countries tax considerations are less important for investment decisions. Tax rates are lower while tax evasion is easier and more frequent. In addition, high rates of inflation reduce the real value of tax obligations if firms succeed in delaying tax payments. Instead, this paper postulates that any negative impact of inflation on private fixed investment in developing countries is rather due to the uncertainty being caused not by high, but by variable inflation rates.

---

[1] For an overview and an empirical comparison of various investment models see Kopcke (1985) and Kutasovic (1983).

Possible impacts of uncertainty caused by inflation depend on the theoretical investment model which is used. Most adequate would be an investment model including the average real interest rate for credits and a variable accounting for uncertainty effects of volatile inflation rates. However, the weighted average interest cost can not be calculated in Peru, since time series data for interest rates in the informal financial sector are not available. Therefore, the following model abstracts from real interest costs on which lower inflation rates and higher nominal interest rates have a symmetric impact. It will only account for the uncertainty following from volatile inflation.

The analysis is based on a flexible accelerator model of private investment spending, where changes in demand induce firms to alter their productive capacity. Other factors such as wages are assumed to have no major independent systematic influence (Kopcke, 1985, p. 21). Thus, gross investment expenditure (I_t) is determined by the capital stock lagged one period (K_{t-1}) and the expected level of output (Q_t^e)[1]:

$$I_t = a_1 Q_t^e + a_2 K_{t-1} \qquad (12)$$

In empirical applications the expected level of output in period t is proxied by a sum of lagged values of actual output. Forecasting future demand from past levels of output is, however, complicated by volatile inflation rates. Firms face the difficulty to distinguish price changes which are part of the general inflation from those which indicate excess demand. In addition, inflation induced changes in relative prices reduce the usefulness of price signals for investment decisions even further (Fischer, Modigliani, 1978). Moreover, unexpected changes of inflation rates biases the firm's assessment of potential investment projects. False projections of future inflation rates may lead to unprofitable investments, since tax laws, depreciation allowances

[1] With respect to the dependent variable gross investment is preferred to net investment, since the latter cannot be explained without considering depreciation losses. Firms generally plan net additions to the existing capital stock and the replacement of worn out parts simultaneously (Heil, 1985).

and accounting rules are based on nominal values[1].

If firms overestimate future demand they will have built up excess capacity. The return to capital is then lower than it would have been with less investment. Profit maximizing firms, therefore, seek to avoid excess capacity. Being aware of possible errors in forecasting future demand due to inflation volatility, risk averse investors correct their demand projections by a risk premium (R). The higher the uncertainty the larger will be the downward adjustments of the expected demand and consequently private capital formation:

$$I_t = \sum_{i=1}^{n} a_1 Q_{t-1} + a_{n+1} K_{t-1} - a_{n+2} R \qquad (13)$$

However, reducing inflation will only foster real capital formation, if it can be confirmed that the volatility of inflation is positively associated with the level of inflation.

2. Empirical Evidence from Peru

After the first oil price shock inflation accelerated in Peru and, due to inflexible interest rate ceilings, real interest rates became negative in 1974 (Table 1). In an attempt to stimulate financial savings in late 1978 and again in January 1981 the authorities partly reformed the financial system. Interest rate ceilings were significantly adjusted upwards in order to account for the rising rates of inflation and deposits denominated in US-Dollar were introduced. Since the devaluation of the Sol against the Dollar roughly compensated the higher rate of inflation in Peru relative to the United States, the Dollar-deposits were actually indexed deposits meant to stop currency substitution and capital flight. The inflation rate, however, could not be brought down. Therefore, increasing inflation rates soon eroded the positive effect of the shifts in interest rate ceilings on real interest rates, thus favouring the growth of dollar depo-

[1] Halloran and Lanser (1983) show that even inflation adjusted accounting is not free from inflation biases due to the inherently uncertain nature of inflation forecasts.

Table 1 - Private Investment, Inflation, and Interest Rates in Peru 1973-85 (per cent)

Year	Private Investment/ GDP	Rate of Inflation[a]	Inflation Variability[b]	Nominal Effective Interest Rate on Credits[c]
1973	7.4	9.5	3.7	15.3
1974	7.6	16.9	1.1	15.3
1975	9.6	23.4	2.5	15.3
1976	8.5	33.1	7.5	18.2
1977	7.4	38.5	5.5	23.4
1978	6.8	56.9	12.1	31.7
1979	7.5	68.2	5.0	52.5
1980	8.9	59.4	4.0	53.0
1981	10.3	75.5	4.4	71.1
1982	9.7	63.9	4.6	69.6
1983	6.8	108.7	17.1	76.2
1984	6.1	111.8	8.3	96.1
1985	5.6	160.1	23.4	114.8

[a]Average annual change in the cpi. - [b]Standard deviation of monthly inflation rates, annualized. - [c]Includes comissions, discounting of credits, quarterly compounding of interest.

Source: Banco Central de Reserva del Perú, Memoria, various issues and unpublished material; own calculations.

sits relative to financial savings in national currency. In 1984, about 65 p.c. of all quasi-money was held in US-Dollars.

Empirical concepts of inflation volatility generally measure only partially the uncertainty caused by volatile inflation rates[1]. Three different measures are used to capture all effects. Similarly to Logue, Willet (1976) and Heitger (1985) the standard deviation of yearly inflation rates is applied to proxy inflation volatility. In particular, the standard deviation (PSTD) is calculated from monthly changes in the price level (P) relative to the price level of the same month of the preceding year:

$$PSTD_t = \sqrt{\frac{\sum_{i=1}^{12} \left(\left(\frac{P_{i,t}}{P_{i,t-1}} - 1 \right) \times 100 \right) - \bar{\Delta P}_t)^2}{12}} \qquad \text{with } \bar{\Delta P}_t = \frac{1}{12} \sum_{i=1}^{12} \left(\left(\frac{P_{i,t}}{P_{i,t-1}} - 1 \right) \times 100 \right) \qquad (14)$$

However, as Foster (1978, p. 347) notes, the standard deviation cannot distinguish between a situation with continuously increasing inflation rates and inflation which rates fluctuate around their mean. In both cases the standard deviation may be the same, while the continuously increasing inflation causes less uncertainty as firms can adjust their expectations to the stable growth of inflation. In order to correct for this deficiency Foster (1978) and Blejer (1979) measure uncertainty by the absolute mean of changes in past inflation rates.

A similar variable has been constructed using the absolute differences of monthly changes in the price level relative to the preceding year:

$$PDIFM_t = \frac{1}{12} \sum_{i=1}^{12} \left(\left| \frac{P_{i,t}}{P_{i,t-1}} - \frac{P_{i,t}}{P_{i,t-1}} \right| - 1 \right) \times 100) \qquad (15)$$

[1] In general absolute and relative measures have to be distinguished. The latter are calculated by normalizing the variability by the mean level of inflation. This assumes that for example a deviation of 2 percentage points from the average inflation of 4 per cent has the same consequences as a deviation of 50 percentage points from the average inflation rate of 100 per cent. However, most authors agree that this assumption cannot be sustained, since economic decisions are influenced by absolute deviations.

Finally, uncertainty results from false projections of future inflation rates. This type of inflation induced uncertainty is proxied by the absolute difference of expected inflation ($\Delta\bar{P}^e$) and actual inflation ($\Delta\bar{P}$):

$$PUN_t = |\Delta\bar{P}^e_t - \Delta\bar{P}_t| \qquad (16)$$

It is assumed that individuals form their expectations on the basis of past levels of actual inflation (adaptive expectations). Expected inflation is the substituted by actual inflation lagged one and two periods where the weights decline geometrically and are constrained to one.

Firstly, it is investigated whether the three measures of inflation variability are positively associated with the level of inflation. Otherwise policies to lower inflation rates will not be able to reduce uncertainty. Each measure of uncertainty has been regressed on the level of inflation using the only data available, i.e. changes of the consumer price index. All regressions were run over the period 1968 to 1985 with the ordinary-least-squares-technique.

From Table 2 it can be seen that in the case of Peru the uncertainty of inflation increases unambiguously with the level of

Table 2 - The Relation between the Level of Inflation and Uncertainty in Peru[a], 1968-1985

Measure of Uncertainty	Const.	$\Delta\bar{P}$	Peru $\bar{R}^2$	D.W.	Q[b]	N[c]
PSTD	0.55	0.115***	0.71	2.19	5.75	18
	(0.48)	(6.47)			(0.76)	
PDIFM	0.60*	0.043***	0.80	1.60	2.83	18
	(1.77)	(8.28)			(0.97)	
PUN	1.20	0.252***	0.72	2.16	4.01	18
	(0.50)	(6.70)			(0.91)	

[a]t-values in parentheses. - [b]Ljung-Box-Q-statistic, level of significance in parentheses. - [c]Number of observations. - *Significant at the 10 per cent level. -***Significant at the 1 per cent level.

Source: BCRP, Memoria, various issues; own calculations.

inflation irrespective of the uncertainty measure used. In all regressions the coefficient for the level of inflation is positive and statistically significant at the 1 per cent level.

Having identified the positive association between inflation volatility and the level of inflation, the negative impact of inflation induced uncertainty on fixed investment in Peru is tested econometrically. Starting from equation 9 expected output and the risk variable (R) have to be specified. In the estimated equation expected output is proxied by real output lagged one period. Further lags did not prove to be significant nor did they improve the coefficient of determination adjusted for the degrees of freedom. Assuming a linear relationship between the risk variable (R) and uncertainty being caused by inflation, the three measures of inflation volatility are used to measure inflation risk.

An initial estimation with annual observations over the period 1968 to 1985 and the ordinary-least-squares-technique revealed autocorrelation of the residuals. The Durbin-Watson test statistics lay in the inconclusive range. However, the values of the Ljung-Box-Q-statistic rejected the hypothesis that the first 9 (8 in equation 2) autocorrelation coefficients are white noise. In order to determine the nature of the autocorrelation process, the autoregressive parameters have been estimated. On the basis of these estimates the filtered-least-squares-technique was applied. The results are shown in Table 3.

According to the adjusted coefficients of determination the overall fit of the regressions is reasonably well. The problems of autocorrelation have been solved. As expected the lagged output turned out to be the single most important variable in determining the current level of real private capital formation. The relatively poor performance of the lagged capital stock may at least partially be attributed to the lack of reliable capital stock estimates in Peru. The coefficients for all three variables measuring inflation induced uncertainty are negative and statistically significant at the one per cent level. The results,

Table 3 - The Impact of Inflation Uncertainty on Private Fixed Investment in Peru[a], 1970-1985

	Const.	Y	K	PSTD	PDIFM	PUN	$\bar{R}^2$	D.W.	Q[b]	N[c]
1.	-21483.6***	0.11***	0.04*	-551.3***			0.92	2.05	6.66	15
	(-3.32)	(11.38)	(1.90)	(-6.28)					(0.47)	
2.	-25356.7***	0.12***	0.04*		-1660.6***		0.92	2.19	4.58	14
	(-3.40)	(10.65)	(1.84)		(-5.54)				(0.71)	
3.	-7185.3	0.10***	0.02			-211.8***	0.75	2.0	7.0	16
	(-1.12)	(6.20)	(0.45)			(-4.51)			(0.54)	

[a]t-values in parentheses. - [b]Ljung-Box-Q-statistic, level of significance in parentheses. - [c]Number of observations. - *Significant at the 10 per cent level. - ***Significant at the 1 per cent level.

Source: BCRP (1976); BCRP, Memoria, various issues; INE, Cuentas Nationales del Perú, various issues; own calculations.

therefore, confirm the proposition that firms reduce fixed investments if the inflation variability is relatively high.

V. Conclusions

Increases in real interest rates for bank credit are often perceived as offsetting the positive impact of financial liberalization on private investment. In the preceding analysis it was evaluated how higher interest rates on deposits influence the interest costs for private firms. The discussion showed that interest rate reforms should be accompanied by deregulative measures which increase competition in the banking industry. Resulting gains from lower monopoly profits and more efficient intermediation can at least partially finance higher deposit rates. Furthermore, even if bank credits become more expensive, financing costs of all firms taken together do not necessarily rise. While the interest burden increases for the previously privileged borrowers, financing costs decline for those firms which have been confined to the informal financial sector before the financial liberalization was implemented. A precondition is,

however, that banks are willing and able to use their additional funds to extend credits to borrowers previously being rationed due to risk considerations. Finally, in order to be able to discriminate between alternative measures to raise real interest rates an aggregate investment model has been formulated. It incorporates the effects of inflation induced uncertainty on the business forecasts of risk averse investors. The empirical analysis with Peruvian data showed that firms reduce their real capital formation in Peru if domestic inflation variability rises. In addition, the empirical investigation confirmed a positive relationship between the level and the variability of inflation. It can thus be concluded that financial reforms can stimulate private real capital formation more effectively if deflationary measures are employed to increase real interest rates.

Data Sources

Banco Central de Reserva del Perú (BCRP), Cuentas Nationales del Perú: 1960 - 1974, Lima 1976.

--, Memoria, various issues.

--, Perú: Compendio de Estadísticas Monetarias 1959 - 1984, Lima 1985.

--, Tasas de Interes en Moneda National, Lima 1986, unpublished.

Instituto Nacional de Estadistica (INE), Cuentas Nacionales del Perú, various issues.

Superintendencia de Banca y Seguros, Memoria, Lima, various issues.

REFERENCES

Acharya, S., S. Madhur, "Informal Credit Markets and Black Money: Do They Frustrate Monetary Policy?" Economic and Political Weekly, Vol. 18, October 1983, pp. 1751-1756.

Alonso, Horacio A., "Role of Interest Rates in the Channelling of Savings: the Experience of Argentina". In: United Nations, Department of International Economic and Social Affairs (Ed.), Savings for Development, New York, 1984, S. 182-185.

Blejer, Mario I., "The Demand for Money and the Variability of the Rate of Inflation: Some Empirical Results". International Economic Review, Vol. 20, 1979, No. 2, pp. 545-549.

Cho, Yoon J., "Inefficiences from Financial Liberalization in the Absence of Well Functioning Equity Markets". Journal of Money, Credit, and Banking, Vol. 18, 1986, No. 2, pp. 191-200.

Corsepius, Uwe, Erfolgsbedingungen einer Zinsliberalisierung in Entwicklungsländern. Kiel Working Paper, No. 251, Kiel 1986.

--, Bernhard Fischer (a), Interest Rate Policies and Domestic Savings Mobilization: A Survey of the Empirical Evidence of Asian Countries. Asian Economies, No. 62, September 1987, pp. 45-64.

--, --, (b) Domestic Resource Mobilization in Thailand: A Success Case for Financial Deepening? Kiel Working Paper, No. 307, Kiel, December 1987.

Fischer, Bernhard, Liberalisierung der Finanzmärkte und wirtschaftliches Wachstum in Entwicklungsländern, Kieler Studien, No. 172, Tübingen 1982.

--, Ulrich Hiemenz, Peter Trapp, Argentina, The Economic Crisis in the 1980s, Kieler Studien, No. 197, Tübingen 1985.

Fischer, Stanley, "Towards an Understanding of the Costs of Inflation: II". In: Karl Brunner, Allen H. Meltzer (eds.), The Costs and Consequences of Inflation, Carnegie-Rochester Conference Series on Public Policy, Vol. 15, 1981, Amsterdam, pp. 5-42.

--, Franco Modigliani, "Towards an Understanding of the Real Effects and Costs of Inflation". Weltwirtschaftliches Archiv, Vol. 114, 1978, No. 4, pp. 810-833.

Foster, Edward, "The Variability of Inflation". The Review of Economics and Statistics, Vol. 60, 1978, No. 3, pp. 346-350.

Fry, Maxwell J., "Models of Financially Repressed Developing Economies". World Development, Vol. 10, 1982, No. 9, pp. 731-750.

Galbis, Vincente, "Financial Sector Liberalization under Oligopolistic Conditions and a Bank Holding Company Structure". Savings and Development, Vol. 10, 1986, No. 2, pp. 117-140.

Gupta, Kanhaya L., Finance and Economic Growth in Developing Countries, London 1984.

Halloran, John A., Howard P. Lanser, "Inflation-Induced Biases in the Evaluation and Selection of Capital Investments". The Financial Review, Vol. 18, 1983, No. 4, pp. 314-325.

Hanson, James A., "High Real Interest Rates and Spreads. An Introduction". In: James A. Hanson, Roberto de Rezende Rocha, High Interest Rates, Spreads, and the Costs of Intermediation, The World Bank (ed.), Industry and Finance Series, Vol. 18, Washington 1986, pp. 1-16.

Heil, Johann, Akzelerationstheorie, Regensburg 1985.

Heitger, Bernhard, "Bestimmungsfaktoren internationaler Wachstumsdifferenzen". Die Weltwirtschaft, 1985, No. 1, pp. 49-69.

Kopcke, Richard W., "The Determinants of Investment Spending". New England Economic Review, 1985, July/August, pp. 19-35.

Kutasovic, Paul R., A Study of Investment Behaviour: A Comparison of Alternative Models, New Brunswick 1983.

Logue, Dennis E., Thomas D. Willet, "A Note on the Relation Between the Rate and Variability of Inflation". Economica, No. 170, Vol. 43, 1976, pp. 151-158.

Maloney, Michael T., Joseph Prinzinger, Holley Ulbrich, "Capital Formation in an Inflationary Environment". Southern Economic Journal, Vol. 48, 1982, No. 3, pp. 651-661.

Moore, Basil J. A.H.M. Nuruddin Chowdhury, Domestic Savings in Selected Developing Asian Countries. Asian Development Bank Economic Staff Paper, No. 2, Manila 1981.

Nunnenkamp, Peter, "Liberalisierung der Finanzmärkte und Ersparnisbildung in Indonesien". Kredit und Kapital, Vol. 19, 1986, No. 3, pp. 417-440.

Rocha, Roberto de Rezende, "The Costs of Intermediation in Developing Countries: A Preliminary Investigation". In: James A. Hanson, Roberto de Rezende Rocha, High Interest Rates, Spreads, and the Costs of Intermediation, The World Bank (ed.), Industry and Finance Series, Vol. 18, Washington 1986, pp. 17-82.

Roe, Allen R., Interest Rates, Employment and Income Distribution: A Review of Issues. International Labor Office, International Employment Policies, Working Paper No. 3, Geneva 1986.

Susano, A. Reynaldo L., "Flujo de Fondos del Mercado Informal de Capitales". Diagnostico y Debate, Lima 1983.

Snowden, P. N., "Financial Market Liberalisation in LDCs: the Incidence of Risk Allocation Effects of Interest Rate Increases". The Journal of Development Studies, Vol. 24, 1987, No. 1, pp. 83-93.

Wijnbergen, Sweder van, Interest Rate Management in Developing Countries: Theory and Simulation Results for Korea. World Bank Staff Working Papers, No. 593, Washington 1983.